Correlation between Short-Term Memory and Achievement of Athletes

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Abstract

Background: Human activity is largely related to thought processing or cognition. One of the most important components of cognition is memory. Individuals who undergo heavy activities, such as athletes, use a lot of memory in the subject's activities, especially during competitions. The purpose of this study was to find out whether there was a correlation between the capability of short term memory with the performance of an athlete during a competition, especially those measured by achievements.

Methods: This study was an analytic observational correlation study with a cross-sectional design and involved 201 athletes as respondents from 12 branches of sports. The study was conducted in the Indonesian National Sports Committee (KONI) building from September to November 2015. Digit Span Forward and Backward were used to collect short term memory data and was performed after a consent form and the respondent's identity was recorded. The athlete's achievements data was gathered by an interview and recapitulation of athlete's achievements in the last five years.

Results: OA total of 186 data was analyzed and found a negative and insignificant correlation between achievement and short-term memory based on digit span tests both forward (r=0.095 p=0.196) and backward(r=0.039 p=0.196).

Conclusions: There is no correlation between short term memory and the achievements of an athlete.

Keywords: Achievement, athlete, short term memory

Introduction

The mind's ability is the competence for thinking and processing thought from all sources. The received information will be processed and attained systematically in the human mind.The capability of thought arrangement is called cognition.[1] A study by Bull et al.[2], shows that there is a relationship between the cognitive ability and achievements in grade 4 students in an elementary school in USA, especially in reading and mathematics. This proves the importance of cognition especially in an individual's life performance, one of them being achievements.[2] The most important part in information processing is memory. After processing, the information will be stored in the brain for future reuse in many daily activities. There are three types of memory which is differentiated by the length of time in the memory storage named long-term, intermediate and short-term memory.[3] Short term memory has a storage capacity of about seven items for 20–30 seconds.[4] Short term memory is needed in the recalling of information that originated from long term memory, the selection of information, repetition of information that are received and stored, and also as a choosing response, which plays a vital role in all the individual activities. A study by Swanson[5] proves that the short term verbal memory has a relationship with achievements especially in language studies and mathematics in children and adults.

Furthermore, Short term memory is also needed in a special community, such as athletes. A few studies have proven that routine exercises could increase the cognitive function including memory.[6,7] Athletes undergo routine exercises to improve the performance on the field during a competition and to maintain good physique. An athlete's sports performance on the field consists of the athlete's capability and achievement, the characteristics of their performance in a competition, a fair behavior, integrity, and an appreciation for friend or foe.[8]

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Short-term memory plays a role in an athlete's performance, for example, an athlete is required to remember strategic tactics instructed by the coach either before or during a break in competitions to maximize the athlete's performance. The performance of an athlete can be clearly seen and measured through the achievements, namely the medals. To our knowledge, there is not a study that shows a correlation between short term memory and an athlete's achievements. This study aimed to discover and analyse the correlation between short term memory and the athlete's achievements.

Methods

A cross-sectional analytic study was conducted from September to November 2015 in the Indonesian National Sports Committee (*Komite Olahraga Nasional Indonesia*, KONI) West Java building, and approved by the Health and Research Ethics Committee, Faculty of Medicine, Universitas Padjadjaran. The subjects for this study were 201 athletes of West Java KONI from 12 branches of sports comprising pencak silat, judo, athletics, archery, fencing, taekwondo, rock climbing, boxing, heavy lifting, gymnastics, wrestling and kempo. The sample collection in this study was obtained used the total sampling method and the correlative analysis sample size formula with α 5%, β 10%, and R 0,7 from previous studies, and turned out to be 14.5 The inclusion criteria were athletes who were willing to participate in the study, had filled out an informed consent form, and completed 90–100% of their training program. Short term memory was assessed by using the digit span forward and backward instrument that was part of the Wechsler Adult Intelligence Scale (WAIS) IV and Wechsler Intelligence Scale for Children (WISC) IV cognition test which was validated.[9–12] Additionally, training before handling, suitability test for intra-observers and inter-observers, and athlete identification was conducted before data collection.

Digit Span Forward Test was performed by requesting the athlete to repeat a sequence of numbers stated by an examiner. A score of 2 was given if the athlete repeated the sequence correctly, while a score of 0 was given if the sequence could not be repeated accurately. The questionnaire with two wrong answers was considered finish, and the athlete's score was written on an evaluation form.

Digit Span Backward test was then carried out, where an athlete repeated the numbers stated by an examiner but in a backwards

Table 1 Characteristics of Participants

Variables	Frequency	Percentage (%)
Sex		
Male	91	49
Female	95	51
Sport		
Pencak Silat	23	12
Judo	21	11
Athletics	12	6
Archery	14	8
Fencing	15	8
Taekwondo	14	8
Rock Climbing	20	11
Boxing	6	3
PABBSI	12	6
Gymnastics	15	8
Wrestling	4	2
Kempo	30	16

Table 2 Measurement of Study Data Dispersion

	Median	Minimum	Maximum
Score			
Achievement	3	1	16
Digit Span Forward	10	6	16
Digit Span Backward	6	4	16

sequence. A score of 2 was given if the athlete repeated the backwards sequence correctly, while a score of 0 was given if the backwards sequence could not be repeated accurately. The questionnaire with two wrong answers was considered finish, and the athlete's score was written on an evaluation form.

The achievement data was about the latest medals attained by the athletes from previous competitions, and information was obtained from interviews with the athletes. The medals might be gold, silver or bronze that the athlete received in state, national or international events.

The data was analyzed using statistical application. The normality test was performed using the Kolmogorov-Smirnov test. The normality results were used to determine the type of correlation test that would be conducted.

Results

Out of 201 athletes included in the study, 186 eligible athletes were recruited, and 15 were excluded as they had not completed the tests. According to the branch of sports, the highest frequency of respondents was from the Kempo branch (16.1%) and was dominated by female athletes (51.1%) (Table 1).

The results showed that either the independent or dependent variables presented a data distribution which was not normal. Thus, to display the statistics of this study in a descriptive way, a median was used as a measurement of central tendency and a minimum maximum as a measurement of dispersion (Table 2).

Moreover, results of the Spearman's test showed an insignificant negative correlation between Digit Span Forward and achievements, as well as between Digit Span Backward and achievements (Table 3).

Discussions

The Spearman correlation test showed that there was a negative and insignificant correlation between the short term memory and the athlete's achievements. Additionally, a study by CDC[13] showed that physical activities could influence the cognitive ability of someone by an increase in the growth of brain capillaries, oxygenation, blood pressure, neurotrophin production, number of neurotransmitters, growth of nerve cells in the hippocampus, development of nerve connections, volume of brain tissue and density of interneuron relationships. This causes an increase in the functionality of attention, information processing, information storage and repetition; it also increases coping mechanism, heightens positive behavior and reduces the sensation of pain.This study also showed that there was an influence of physical activity to academic performance. Aerobic exercises in the form of group games, especially those that needed complex motoric activities (example; football), could increase prefrontal cortex activities, and increased the positive marginal effect in mathematical achievements.

Furthermore, Sun et al.[14] stated that the brain's functional magnetic resonance

Table 3 Correlation Analysis Test Result

		Digit Span Forward	Digit Span Backward
Achievement	Spearman Correlation	-0.095	-0.039
	P-value (2-tailed)	0.196	0.594
	N	186	186

imaging (fMRI) test results on the prefrontal cortex activitiy especially in the Dorso Lateral Prefrontal Cortex has a major role in the short term memory function. Short term memory has a correlation with achievements in language studies and mathematics in children and adults.[5] This shows that short term memory influences an individual's achievement. There are a few factors that influence the memory function of an individual, one of it is concentration. Duration, intensity and time of stress as intrinsic factors could also influence memory.[15] Stress will activate the Hypothalamic-pituitary-adrenal (HPA) Axis and increase the rate of glucocorticoid, cortisol in humans. The increase of the glucocorticoid rate could decrease memory function.[15,16]

Athletes are people who experience a lot of physical activities with specific training regimes. The main purpose of an athlete is to win competitions and to garner achievements in the form of medals.[17] Sports performance of athletes are influenced by cognitive function, stress factor, confession of physical or mental mistakes on the field, frequent endurance of pain and unease on the field, seeing successful or cheating rivals on the field, getting a violation from the referee, and being reprimanded by the coach. The failure of the coping mechanism with acute stress levels could lead to change in the psycho-behavioral processes of the athlete.[18]

This study was not focused on the measurement of short term memory quality as an effect of an athlete's physical activity. This study was focused on the short term memory and the achievement of athletes due to a relationship between athletes who endure loads of exercise and the increase of cognitive function, especially the short term memory.

In conclusion, there is no correlation between the West Java KONI athlete's short term memory capability and their achievements, and this may occur due to a few factors that in turn influenced the athlete's performance on the field aside from the short term memory. There are also factors that influenced short term memory when the test is conducted, such as concentration.

This study has several limitations. The researcher did not measure the stress factor and the concentration that may influence the athlete's achievements in competitions and memory function during data collection. This is due to the insufficient study time.

Recommendations for athletes are to maintain factors that can influence the athlete's performance on the field. One of them is the role of KONI to measure also the cognitive function and stress factor of the athletes regularly before a match. Recommendations for a future study are to conduct carry out a study with cohort method by measuring the short term memory of the athletes before a competition and to observe the development of the athlete's performance. Further recommendations are to measure and to control positive factors that may influence the short term memory or an individual's performance. Additionally, to evaluate the part of the brain that activates the short term memory directly during the study by using fMRI.

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